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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Paper No. 12103

Application Number: 09/270,606
Filing Date: March 17, 1999
Appellant(s): EVANS, DAVID RUSSELL

Matthew D. Rabdau
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 9/12/2003.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) Status of Claims

The statement of the status of the claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Invention

The summary of invention contained in the brief is correct.

(6) Issues

The appellant's statement of the issues in the brief is correct.

(7) Grouping of Claims

Appellant's brief includes a statement that claims 1-3,5-6,10-11, claims 4,7-9,12,16, claims 13-14, claim 15, claims 17-19, and claim 20 do not stand or fall together and provides reasons as set forth in 37 CFR 1.192(c)(7) and (c)(8).

The groups are separately argued in the brief.

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of R cord

5445996	Kodera et al.	8-1995
5,759,917	Grover et al.	6-1998
5,934,978	Burke et al.	8-1999

For the above reasons, it is believed that the rejections should be sustained.

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

1. Claims 1-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kodera et al. (US 5,445,996) in view of Grover et al. and further in view of Burke et al. (US 5,934,978).

Kodera et al. discloses a method for planarizing an insulating film using an aqueous slurry containing dispersed cerium oxide in col. 19-20 as the preferred embodiment. In Fig. 19, the polishing method of overlaid SiO_2 insulation on a polysilicon patterned layer is described visually. The recesses between the raised portions were seen in Fig. 19E. Fig. 19F shows a planar surface. In col. 20 lines 45-50, the surface is described as completely planarized. This implies that the high structures are preferentially polished until they are removed. This in turn implies the rate of polishing the high structure areas at a higher rate than the low areas. Otherwise planarization would not be attained. In col. 44 lines 3-11 the use of a surface active agent is disclosed. Kodera et al. discloses the optimization of friction to cause a uniform polishing rate. It is obvious to those of ordinary skill in the art that the processing

parameters such as abrasive concentration and pressure applied will affect the friction in a direct relationship. The lack of an etch stop layer or dummy structure is disclosed in col. 37 lines 44-64. The complete planarization of an insulating film with undulations is described as not requiring a dummy structure (i.e. a etch stop or polishing stop layer). Fig. 51 discloses shows a near constant polishing rate when using a surfactant (one which was disclosed as not limited to polycarboxylic acids) in the slurry to keep the slurry from choking the polishing cloth. The slurry so modified is shown to polish at a near constant rate over time regardless of the target structure polished (col.44 line 10).

Kodera et al. does not explicitly disclose the use of ethylene glycol in such a slurry.

Grover et al. discloses a method of chemical mechanical polishing (CMP) using a slurry containing cerium oxide (Col. 4 lines 40-45). The slurry also contains an additive (i.e. a modifier) comprised of a carboxylic acid. The method is disclosed as useful for STI (shallow trench isolation). STI is discloses in Col. 1 lines 25-37 as follows: silicon nitride is deposited over a thermal oxide; a shallow trench is etched; a layer of oxide is deposited over the into the trench; the excess oxide is polished using CMP such that the surface is planar (i.e. the high spots are removed and the low spots are essentially untouched. In Col. 5 lines 60-63 the percentage of the metal oxide abrasive is disclosed as from about 2-25 % by weight. In Col. 7 lines 40-53 is described the methods of the enclosed Examples including the down force of 9 psi.

Burke et al. discloses in Cols. 3 and 4, lines 60+ and 1-9, respectively, the addition of a suspension agent which improves the colloidal behavior of the abrasive

particles in deionized water and inhibits the coalescence of the particles. Ethylene glycol is disclosed as an alternative suspension agent. In col. 4 lines 9-15, ceria (i.e. cerium oxide) is disclosed as the abrasive particles in the slurry. Those of ordinary skill in the art know that the terms surface active agent or surfactant are equivalent to the term suspension agent.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the references cited because Kodera et al. discloses a CMP process where the ceria containing slurry polishes the high spots at a nearly constant rate while the low spots are virtually untouched, Grover et al. adds known process parameter data to the mix, and Burke et al. discloses the use of a suspension agent (ethylene glycol) which would increase solubility of the colloidal particles of ceria and help it stay in the aqueous solution and not coalesce.

In regard to claims 1, 10-11, 14,16, 17 it would have been obvious to one of ordinary skill in the art at the time of the present invention to form a slurry containing ceria , use that ceria containing slurry to polish the high spots of a SiO_2 structure at a nearly constant rate (without the use of a dummy or polish stop layer) while the low spots are virtually untouched because such a method is described by Kodera et al. in Figs. 19 and Fig. 51 of Kodera.

In regard to claims 2-9, 12, 18, 19, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the process parameters of cerium oxide (ceria) concentration between 1%-50% weight (Kodera et al) and

pressure between 5-10 psi because these were known in the art (Grover et al.) and such optimization would have been achieved with only routine experimentation.

In reply to claims 4,7,8,15, 20, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the amount of ethylene glycol in such a slurry because the addition of ethylene glycol in a ceria-containing CMP slurry to affect the suspension and ultimately the polishing properties of the slurry was known, such optimization would have been anticipated to produce an expected result, and such optimization would have been achieved with only routine experimentation. Kodera et al. discloses that surfactant in the slurry keeps the polishing rate constant by preventing the "choking" of the polishing pad in Col. 44.

(11) Response to Argument

The argument that the examiner has engaged in inappropriate hindsight analysis is not convincing. The applicant wishes to make "dishing" a part of his claims when they clearly are not present anywhere in the applicant's claims. The examiner notes the description of Figs. 19 of Kodera which describes a planarized resultant surface after using the CMP slurry disclosed. (See col. 19-20, lines 40+ and 1-8, respectively, for a verbal description.) The slurry is described in col. 12, lines 48-55, as including CeO_2 (cerium dioxide or, equivalently, ceria) and H_2 (believed to be H_2O since later descriptions describe the slurry as ceria dispersed in water). Impurities (listed as Na, K,

and other alkali metals or compounds of these metals) are permitted in the slurry to a concentration less than 100 ppm.

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). Kodera et al. discloses a ceria slurry *dispersed* into water. Burke et al. discloses known *dispersion agents* (aka. suspension agents or surfactants or surface active agents),which improve the colloidal behavior of the abrasive particles and inhibits growth and/or coalescence of the particles, including glycols such as *ethylene glycol*, propylene glycol, glycerol, polyethers such as polyethylene glycol, aliphatic polyethers, and alkoxylated alkylphenols for ceria CMP slurries. The examiner notes that the claimed ethylene glycol does not contain alkali metals restricted by Kodera et al. Glover et al. discloses a ceria slurry having a modifier of carboxylic acid including poly (ethylene glycol)bis(carboxylmethyl) ether (a poly ether as in Burke et al.). Thus, one of ordinary skill knew of the use a ethylene glycol as a dispersion agent in a ceria slurry used to planarize a surface. Kodera et al. discloses that such a dispersed slurry achieves planarization and does not require a dummy feature in the description of Fig. 19 and the process used to achieve those depictions.

In regard to the arguments on pages 7-9 of the brief concerning Kodera et al. and dishing, the examiner notes that "dishing" is not in the claimed invention. And, as above Kodera et al. discloses a planarized surface in one embodiment of the present invention. The examiner notes that cited Figs. show prior art and not the invention of Kodera et al. of which, to be redundant, Figs. 19 are a part. In short, dishing is not shown to be a problem in Figs. 19 which has no dummy structures.

The argument concerning the use of a surface active agent in col. 44 of Kodera et al (page 9 of brief) is convincing. However, Kodera et al. specifies a dispersed ceria in water, which, according to the Burke et al. and Glover et al. references, was conventionally achieved by using a dispersing agent (aka. a surfactant) such as ethylene glycol.

The argument against Glover et al. is not convincing. Planarization occurs in Glover et al. just as planarization occurs in Kodera et al. The argument hinges on what a substantially zero rate of polishing means. From Fig. 19E to Fig. 19F one of ordinary skill would surmise that the rate of polishing in the recesses was substantially zero since the thickness of the planarized oxide surface and the thickness of the recessed oxide surface of the not planarized surface were the same.

The argument against Burke et al. is not convincing. Burke et al. discloses known ceria slurry dispersing agents. Kodera et al. requires a dispersed ceria slurry in water.

Issue 1. In Kodera et al. Fig. 19, planarization is achieved with out a dummy structure using a dispersed ceria slurry. Fig. 19 at least suggests an essentially zero

polishing rate in the recesses. Fig. 18 discloses an essentially constant polishing rate during the time of polishing. This suggests that the polishing rate of Kodera is approximately constant from initial polishing of the projections of the silicon dioxide until the surface is planar.

Issue 2. The combination of references suggests polyethylene glycol as a dispersion agent useable to achieve the ceria dispersed in water slurry used by Kodera et al. to planarize the silicon dioxide surface.

Issue 3. The forming a slurry having some rate of polishing then adding the modifier is at least suggested to one of ordinary skill. The slurry of the claims is modified by adding a modifier to a slurry. The combined references suggest a ceria slurry with a dispersant added. The slurry suggested has the same composition as that claimed and, as shown by Kodera, achieves virtually identical results.

Issue 4. Ethylene glycol was suggested by the references as a dispersant agent.

Issue 5. The examiner notes Figs. 20 A-C which show different size features spaced apart at differing intervals (210) which is planarized with the aqueous ceria polishing slurry. (see also col. 23 lines 34-15) Thus, a surface with high and low density areas is shown. And, when polished according to the Kodera et al., planarization occurs. This at least suggests a uniform (i.e. essentially the same) high structure polishing rate in both high and low density areas. Down pressure was taught by Grover et al.

Issue 6. Ethylene glycol was suggested by the references as a dispersant agent.

Respectfully submitted,

MAA
December 15, 2003

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